ROSS GUNN—THE SCIENTIST AND THE INDIVIDUAL

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In a talk to naval architects and marine engineers at the Naval Research Laboratory, Bellevue, D.C., in 1938 Ross Gunn (fig. 1) had occasion to characterize the ideal research physicist. In fairness he hastened to explain that he did not know anyone who measured up to the "ideal" and never expected to meet one who does! But the words reflect the standards set by Gunn as a scientist. He said "the scientist should be distinguished by intelligence and firm grounding in the fundamentals of physics, chemistry, and engineering. He should be especially keen in estimating situations and reaching sound decisions. His judgment and perspective should be such that he can give his talents systematic direction. He should be an original thinker . . . exceptional in his ability to plan, think, and do things without being told. He should have the courage of his convictions, yet not be blinded by them. He should *constantly seek the truth.* He should be especially successful in working harmoniously with others toward a common end."

As for Gunn personally he appeared to place emphasis for himself on three qualities not uncommon among scholars, scientists, and men of good principles in general, namely—creative thinking, devotion to truth, and hard work. In Gunn the visible features that distinguished him and caused others to remember him after a first meeting were a healthy and wholesome appearance; a friendly, direct, and decisive manner; and a purposeful air. Usually he was frank, sometimes quite outspoken, but not talkative or unkind. On occasion he would quip, "Well, it's the TRUTH, isn't it?" to remind anyone who seemed to be overlooking the facts or hinting that the truth might be unpleasant or personally impolitic.

As for hard work he expressed his belief in this traditional virtue when he wrote on the flyleaf of a gift copy of *Men and Decisions* [1]:

> "To my beloved son, Robert Burns Gunn
> With Best Christmas Wishes, 1962
> 'The Lord gave us two ends; one to think with and the other to sit on.
> Success will depend on which end you really exercise.
> It's a case of—Heads you win; Tails you lose!'
> Love, Pop"

This was not an isolated show of admonition and affection. The family—parents and four sons—was a busy and happy one, each member with a sense of responsibility in life. There was no trifling with matters of good principle. Righteous conduct and useful, purposeful living were important but family "administration" was liberal and there were good mutual understanding and easy communication, each member of the family with the others.

Life and career for Ross Gunn unfolded logically as comprised of four rather distinct periods:

1. The years 1897–1927, naturally the time for growing up, getting an education and a beginner's experience.
2. From age 30, the years 1927–47 at the Naval Research Laboratory (NRL) as research physicist, divisions superintendent, and technical advisor to the Director.
3. The decade (1947–1957) at the U.S. Weather Bureau, Washington, D.C., as Director of Physical Research, acting Assistant Chief of Bureau (1955–56), and director of field experiments in cloud physics (the mine-shaft laboratory, the helium sphere, and others).
4. The final years (1957–1966) of individual researches mostly as Research Professor at the American University,

FIGURE 1.—Dr. Ross Gunn, 1897–1966. (Photo about 1955.)

Washington, D.C., working on problems of his selection, sponsored in part by the Atomic Energy Commission, the National Science Foundation, and others.

1. THE YEARS 1897–1927

Born May 12, 1897, in Cleveland, Ohio, Gunn 50 years later wrote that his boyhood "was a busy and happy one, constantly stimulated and encouraged by my father whom I adored." He was only 7 years old when his father, Dr. R. D. A. Gunn, transferred family and medical practice to neighboring Oberlin. There Ross grew up and went through the 12 years of public school, completing the courses in Oberlin High School in 1915. He studied at Oberlin College for 2 years and then went to the University of Michigan to have the advantages of improved facilities in electrical engineering. His success with amateur radio operation had led to his decision to get further into studies of electricity. He graduated at Michigan in 1920 with the degree B.S.E.E., and went ahead in graduate work in physics. The following year an M.S., in physics, was his, and he then planned to continue right on at the University of Michigan until he had completed requirements for Ph.D. But other considerations intervened.

Nature and experience together inclined Gunn toward a career in science, in particular, atmospheric physics in a broad sense and somewhat related phenomena in astronomy and geophysics. He credited his forebears with some of the qualities that may make a scientist—courage, originality, persistence, love of truth, and discernment. No doubt during his sapling years the pruning influence of parents, family life, and the fairly quiet college town environment were all important.

Ross' father and mother were of sturdy stock from Scotland and England. Their close family ties were evident in the reunion of "decendants of John Burns" at the home of Dr. R. D. A. Gunn, who was the organizer and principal speaker for the family gathering of 65 relatives and their immediate families in Oberlin in 1925. Their pioneer forefathers in Pennsylvania and two still earlier sires who distinguished themselves as colonels in the Revolutionary War serving "directly under General Washington," one later becoming a Brigadier General, were favorite subjects of informal talks at the reunion.

Lora Conner Gunn, mother of Ross, was born of prosperous parents near Cumberland, Ohio, and had the rather unusual distinction in those days (1880's) of having finished 2 years of college (Waynesburg, Pa.) before she married R. D. A. Gunn. Six children were born—twins who died at birth, a boy and a girl older than Ross, and a younger boy. Probably this family and other cares that came with being the wife of a busy, popular, and successful physician in a small city were full-time vocation for Ross' mother.

Of Ross' father the *Waynesburg College Bulletin* in March 1936 stated among other things: "The stimulus of these sweeping changes (in the conduct of alumni affairs of the college) began with the speech of Dr. Gunn (father) before the Alumni Association 2 years ago, and was intensified by his noble work of last year in fostering the alumni birthday gift project." That issue of the *Bulletin* was dedicated to R. D. A. Gunn, alumnus, Class of '84 (M.D. from Western Reserve Medical College about 1887–88), who had died in June 1935. The *Oberlin News-Tribune* for June 7, 1935, published a long account of his life as "dean of local physicians" and an editorial in the same paper praised his many years of dedicated and unselfish service to the community as its leading medical doctor. The editorial placed emphasis on several characteristics which are of interest in the present Memorial Issue in view of the influence they must have had on Ross during his youth at home. After eulogizing R. D. A. Gunn for "fine qualities and generous spirit" during 30 years of medical practice in Oberlin and adjoining townships, the editorial went on: "His cheery smile and good humor went hand in hand with his professional skill. He did not hesitate to give his services at any time of day or night whether it was for poor folks or for those able to reimburse him. . . . He had a deep sense of responsibility to his community, to his church, and to other civic activities. His enthusiasm for social benefit did not wane through the years. . . . He implanted a spirit of *love of truth* and helpfulness to those about him." The paternal influence and the college atmosphere of Oberlin certainly took root among the four children. All became college graduates; three including Ross earned advanced degrees, the elder brother in law, and the sister in medicine.

In some ways the subjects selected for keeping in a personal scrapbook may reveal more about the individual than the printed statements in clippings. Ross Gunn's scrapbook seems not to have been a hobby nor an expression of pride but rather was part of his life as a scientist, that is, a recording of essential facts. Naturally it contains a few items of indulgence to pride, but not many.

As regards ancestry he apparently neither overrated nor neglected hereditary elements in the makeup of an individual. He was always ready to speak out for the virtues often ascribed to his ancestors from Scotland, their sturdy nature in physique and spiritual outlook, their reputation for honesty and straightforwardness, in a word—the tenacious devotion to pure truth. Another trait sometimes associated with Scotchmen is implied in a sort of epigram also glued to the inside front cover of Gunn's scrapbook. Likely it was placed there in a puckish moment but it nevertheless conveys a message of one of his mores. Opposite a small drawing of a thistle and a Scotch terrier are the words: "The Scottie Speaks—The thistle, Lad, is Scotch like you and me, And none may sit on any of us three" (by Guiterman and Twelvetrees, publication unknown).

More to the point of youthful indications of the career Ross Gunn would select is a snapshot (fig. 2) of his radio workbench and apparatus captioned, "Ross Gunn (age 14) with homemade 'wireless'." He is seated at the bench wearing earphones, pencil and pad at hand ready to write messages. The photo is placed above the Scottie skit. Beside it is a curious and much later clipping from *Science News Letter* (Science Service), January 2, 1932, on "Mental Ability Increased after Period of Fasting." It summarized

FIGURE 2.—Ross Gunn (age 14) with home-made "wireless."

a report to the American Association for Advancement of Science on experiments made by two psychologists of Kansas State Teachers College. No faddist, Gunn's interest in the item probably was limited to its usefulness as a reminder that diet bears a relation to clear thinking, at least sometimes. The two items, the epigram and clipping on mental ability, are the only extraneous bits that appear in the 175–200 pages of the 8×14-inch scrapbook. It is crowded with clippings on technical devices, scientific studies, and research results, many press clippings, a few copies of official letters and similar papers, practically all relating to Gunn's career. The wholly personal or family items in the scrapbook are few.

Except for occasional times during summer vacations from school when he served as boy newspaper carrier and as repairman's helper in a bicycle shop, Gunn's teenage interests and activities seem to have been centered around radio-telegraphy. This was neither surprising nor unusual. In the 1910's the new field of "wireless" was to young men the mysterious frontier and career challenge that astronautics and outer space are today.

What was unusual in Gunn's involvement in radio was that he was so successful in building and operating his own "radiotelegraph set" he soon received a special experimental license from the Federal Government and was recognized as the outstanding amateur in this field throughout northern Ohio. He set up radio communication with other amateurs and at one time or another exchanged messages through the receiver/transmitter he built, with stations in almost every state east of the Rockies. This success and the recognition he enjoyed in 1915 mostly through the experimental station licensed by the Government led Gunn to concentrate on science fundamentals offered at Oberlin College during his 2 years of undergraduate work there and then to choose the University of Michigan for electrical engineering in his junior and senior years.

After war was declared in 1917 Gunn had enlisted as a private in the Army Signal Corps. Later when called to active duty his special qualifications in radio logically resulted in a billet for continuing him at the University of Michigan as instructor in basic theory and operation of radiotelegraphy for student officers. His talent for teaching and the shortage in number of qualified instructors in radio soon got him a place on special status with the University teaching staff.

At different times during his college years he had taken temporary jobs—probably for the most part during summer vacations. In one of these he was chief radio operator on the large passenger ship *SEEandBEE* which operated on the Great Lakes. At another time he was a radio research assistant in the Cleveland plant of the Glenn Martin Aircraft Company. There he experimented with radio direction finding and telephony for aircraft. Experience in these jobs added to qualifications and reputation in his special field of electrical engineering.

Although experimenting had long been both hobby and part-time vocation, he once wrote that his "first investigative job" grew from suggestions he made to Professor Benjamin F. Bailey, Head of the Electrical Engineering Department at Michigan. As a result Gunn designed a generator with rotating magnetic field in polyphase circuit. This prototype, used in classroom lectures for many years, encouraged Gunn toward more research in magnetism and high frequency electricity. Principally as a result of his admiration for the work of Professor Bailey and his associations with him and with Professor H. M. Randall, head of the Physics Department, Gunn decided in 1920 to take up advanced studies in physics. The income from a part-time instructorship enabled him to finance his living expenses. He conducted recitations in engineering physics and supervised students in the laboratory. Years later he wrote that he enjoyed teaching and got much satisfaction in seeing the growth of knowledge of science in his students. At the same time he continued his graduate studies and laboratory experiments on high frequency power obtained by use of quenched sparks. The research sought to develop a high power radiotelephone.

Gunn obtained his master's degree in physics in 1921 and went on through 1922 as graduate student and part-time instructor at Michigan, fully intending to complete requirements for a Ph.D. But, according to his biographical notes, he "grew restless after 2 years of graduate work" and decided to accept an offer by the military aviation laboratory at McCook Field, Dayton, Ohio, as aircraft radio research engineer. There he had a part in developing the radio range, still widely used as an aid to aircraft navigation, and incidentally he flew on many of the first cross-country test flights "on instruments." He also contributed in developing radio devices for control of pilotless aircraft, his design being used subsequently for Navy "drones" in target practice with anti-aircraft batteries. Gunn's work at McCook Field was the basis for several U.S. patents. (See titles in the list published on page 826 of this issue.)

"Recognizing that I needed further training and that I had been hasty in abandoning my chance for a Ph.D., at Michigan, I resigned from . . . (the laboratory at McCook Field) . . . and accepted a job as instructor in

engineering physics at Yale University" Gunn wrote in his notes many years later. So, after about 18 months as a radio research engineer he again took up work as an instructor and graduate student in physics, this time at Yale in the autumn of 1923. Although the break in his graduate studies set him back a few years in academics he said that the associations formed during those years and the experience and perspective gained were more valuable to him in personal satisfaction and career relationships than anything he could have anticipated or acquired otherwise. During 4 years as instructor at Yale he worked closely with Professors John Zelemy and Leigh Page in the Physics Department and he credits them with stimulating and influencing him for many years. He was an excellent instructor. During his final year at Yale he was placed in charge of the high frequency laboratory of the Physics Department. While at Yale (1923–1927) Gunn experimented in engineering physics, mainly in electrical devices relating to air navigation and radio communications. His dissertation on "Three New Methods in Electrical Measurements" submitted to Yale in 1926 and his 3 years of graduate study and original research earned him the Ph.D. degree. He remained at Yale for approximately 1 more year as instructor and research physicist. That the 4 years (1923–27) there were busy and productive is shown by the titles of published papers and patents listed on pages 821–826 of this issue.

If space taken in preceding paragraphs for reciting Gunn's early occupations and family antecedents appears to be disproprotionate with what follows on his mature years there seems to be good reason. This memoir seeks to bring the scientist and the individual into true perspective as regards his work and the lasting recognition it merits. Any man whose work comes to public attention and who holds to his beliefs when the facts support them encounters opponents as well as supporters especially when his work may incidentally affect the ambitions of others. So Gunn had his critics—this is rather well known. But he has strong support from associates who believe that most of the criticism directed at him was a result of misunderstanding, sometimes misrepresentation or ignorance of what he actually thought and did. Gunn's nature did not make him inclined to waste time in "explaining" to critics. He hoped the facts would speak for themselves and in such matters he preferred to remain silent. This was being faithful to the ancestral traits he respected. Accordingly the review of his early family life and upbringing is helpful in understanding some of the problems he encountered later, and the decisions he made. Moreover, most of his later activities and accomplishments are reflected in the bibliography of his published papers (pp. 821–826) and in the citation of his work in other articles in this issue. In the succeeding sections 2, 3, and 4, it is intended to record chiefly those more individual aspects not likely to be printed elsewhere.

In 1923 before going to Yale, Gunn had fallen in love with Gladys J. Rowley, whose father was a physician. She was a graduate of Oberlin College. They were married in September 1923. Their four children—"the boys"—are Ross Jr. (born 1925), Leigh (1930), Charles (1934), and Robert Burns (1939). The special place of home and family in Gunn's life both as scientist and as an individual is signified all too briefly in later paragraphs. His home was, in fact, his workshop for many important experiments—he kept a laboratory in the basement of his home—and family members frequently doubled as technicians to record data or assist in operating some piece of apparatus.

2. TWO DECADES IN THE NAVAL RESEARCH LABORATORY (1927–1947)

Gunn took a position as research physicist at the Naval Research Laboratory, Bellevue, D.C., expecting to stay not longer than 3 years at most. He took office in August 1927; he transferred to the U.S. Weather Bureau in February 1947 although the Director, NRL, and associates urged him to remain. They offered to set aside more time for his research in atmospheric physics and relieve him of much of his supervisory work, but by 1947 he had identified certain basic problems in the physics of clouds and precipitation that he wanted to solve and he concluded the best available and logical place was in the Weather Bureau.

His remarkable success at NRL is seen in the special positions given him and in certain official papers. Promoted to be Assistant Superintendent of the Heat and Light Division in 1928, he was made Superintendent of the Mechanics and Electricity Division in 1933 and concurrently Technical Advisor to the Director for the entire research program of NRL. In 1944 the position of Superintendent of the Aircraft Electrical Research Division was added to his supervisory responsibilities. He also had the usual special assignments, membership in interagency committees, responsibility for the technical library, etc., that go with positions as head of divisions in large laboratories. He directed these major research activities until 1946 when he asked to be relieved so he would have more time for individual research. Apropos Gunn's accomplishments as organizer and supervisor as well as research scientist, the Director of NRL in April 1935 wrote privately to the new director-elect describing the scope and importance of Gunn's position. The note was written under circumstances that make it practically certain to have been a simple statement of facts as the Director saw them with no gratuitous motives. After describing the responsibilities and Gunn's work in very commendatory terms the note went on: ". . . you will find him (Gunn) a very level-headed advisor on practically any subject that will arise about the scientific work (of the entire Laboratory). He is one of the ablest scientists . . . is comparatively young and full of 'go'." Among other commendations during his years at NRL the citation presented to Gunn on September 4, 1945, by Secretary of the Navy Forrestal said in part (it was a long citation with joint credit to Dr. Philip Abelson and Dr. Gunn for development of a method for separation of the isotopes of uranium):

NAVY DISTINGUISHED CIVILIAN SERVICE AWARD

"For exceptionally distinguished service to the United States Navy in the field of scientific research and in particular by reason of his outstanding contribution in the development of the atomic bomb."

(Here the 11-line paragraph on uranium isotopes.)

"For his untiring devotion to this most urgent project. Dr. Gunn has distinguished himself in a manner richly deserving of the Navy's highest civilian award,"

/s/ JAMES FORRESTAL

The promptness with which this award was given shortly after the first atomic bomb was dropped implies long-standing recognition of Gunn's role. The Laboratory raised his salary to the top level and tried, unsuccessfully, to obtain authority from the Secretary of the Navy to raise it $2,000 above the statutory limit.

Without repeating here the titles of papers and patents that represent Gunn's many research activities, it is germane to record that science news media and the daily press published many articles featuring the aircraft altimeter, electrometer, inductor compass, and other instruments he invented; also his theories on the origin of terrestrial magnetism, the earth and solar system, atmospheric electricity, the source of the sun's heat, the formation of mountains, and related subjects. Especially during the 1930's his theories gave him international as well as nation-wide recognition. Some of his work relating closely to military problems at NRL was classified but eventually most of his original results were cleared for publication.

Two of his accomplishments during the years at NRL are recalled here. These are the precipitation static research project (1943–1946) and the atomic submarine proposal (1939). The one probably gave him the most satisfaction of any single project in his research career; the other led to considerable controversies that involved his work.

The Army-Navy Precipitation Static Project offered most of the circumstances that a scientist finds attractive in research—a phenomenon in nature not understood and of considerable importance theoretically and practically (aircraft had been lost as result of radio "blackouts" in snowstorms), adequate supporting staff and facilities, pleasing environment to work in, and almost complete freedom and independence in planning and operating. The research was based near Minneapolis. It verified that the sudden interruptions to aircraft communications were a result of brush discharges of "static" accumulated on the air-frame in flight. The static discharger now visible on many planes as foot-long tassels trailing from the rear edge of the wing is lasting memorial to Gunn's solution. The Flight Safety Foundation, the Navy Bureau of Aeronautics, and others published glowing commendations for his accomplishment.

An important part of his position at NRL during the 1930's had been theory and experimentation for developing improved means of propulsion for naval vessels, especially for submarines. Many possibilities were studied. For more than 20 years previously the phenomenal energy locked in the atom had been a subject of much interest to physicists. In March 1939 Gunn attended a small conference in which Fermi described a possible way to split the atom and obtain part of its energy for practical use. With Fermi's exposition Gunn immediately urged naval authorities to develop and apply the method to submarine propulsion. In conferences and by letter he pushed the proposal with enthusiasm and vigor. He was the first to obtain funds and do research in atomic energy within the U.S. Government. He appears to have coined the term "atomic submarine." Later Dr. Philip Abelson joined the staff at NRL and together Abelson and Gunn not only developed the method for separation of uranium isotopes for which they received the Navy's highest civilian citation but also they worked out the principles and the practical steps for applying nuclear power to propulsion of submarines. Apparently they had all of the prerequisites for eventually becoming at least the "grandfathers" of the successful atomic submarine *except* official authorization to proceed with the development after they had completed the initial steps. Wartime exigencies led to transfer of atomic research to Oak Ridge and elsewhere and placed the epochal achievement into other hands.

As recently as 1964 a member of Congress introduced a draft joint resolution to give recognition to Abelson and Gunn without detracting in any way from the prestige of the great achievers who came after them and were given the opportunity to complete the gigantic task of producing the operating atomic submarine. The last clipping Gunn pasted in his scrapbook is the account published in the *Washington Post* on June 10, 1964, describing opposition to the proposed Congressional resolution. References [2], [3], and [4] cite documentary proof of the recognition due Abelson and Gunn. Despite this and other normal frustrations that were bound to come to Gunn during his years at NRL, they were his most exciting and productive and probably to him personally, the most gratifying years of his life.

3. DECADE AT THE WEATHER BUREAU (1947–1957)

The transfer from NRL to the Washington headquarters of the U.S. Weather Bureau in February 1947 was Gunn's idea. He wanted to work on fundamental questions he had found over the years in his many experiments in atmospheric physics. He wanted the research environment usually associated with a university, an ideal which he knew the Bureau strongly upheld in policy and in practice. Also he knew the head of the Bureau at that time, an acquaintance dating back to experiments together in measurements of atmospheric electricity from observations aboard airships (dirigibles, etc.) based at Lakehurst, N.J. But his years in the Weather Bureau turned out to be other than tranquil. They were remarkably productive for him but his work became subject to controversy about artificial cloud nucleation (ACN)—rain-making, so-called. From the beginning of his time with the Bureau he much preferred to use full time for basic research in cloud physics and related matters, and at various times he tried resolutely to withdraw com-

pletely into his fundamental research and invention. He felt that an understanding of precipitation mechanisms natural or otherwise, required basic research.

When he planned to organize and enlarge research in atmospheric physics at the Weather Bureau, Gunn had in mind a relatively modest establishment of staff and facilities. In his planning and budgeting he was habitually realistic. He always evidenced a good sense of accountability for public funds and he periodically volunteered reports of status and progress in programs for which he had responsibility. After a fairly generous beginning in appropriations for Gunn's organization, subsequent funding for his research had to come from what the Bureau could squeeze out of its general appropriations. He sometimes remarked that in view of the bearing of his research on the fundamentals of how precipitation is produced in nature and the hoped-for application of such knowledge to improved accuracy in weather forecasting, perhaps even to some sort of weather modification, he could not understand why funding for fundamental research was so inadequate while appropriations for services for uncertain weather forecasting were so generous.

Despite serious problems in funding and employing those he selected for the research staff, a difficulty that came chiefly from the limitations on salaries he could offer, Gunn established the nucleus of an institute of physical research in atmospheric science and went on to achieve several highly creditable "firsts" during 1947–1957. The record of these is to be found in this issue in the bibliography of papers he published (pp. 821–826) and in articles by other authors who cite his work. His findings in the mechanics of electrical charges on cloud droplets and of condensation and coalescence into rain-drops; his theory of the origin of atmospheric electricity; his writings on air pollution, isostasy, and other geophysical subjects; his inventions (see p. 826) and his resourcefulness and scientific and executive ability shown in ACN field tests and in utilization of the mine shaft in Arizona, the large helium storage sphere (fig. 3) in Texas, and the main Laboratory in the Weather Bureau, Washington, D.C., are marks of a great scientist.

A further comment on the ACN episode is justified. Gunn was drawn into the practical sector of this matter, outside his basic research plans, as result of urging by the then Chief of Bureau. Gunn reluctantly accepted the proposal that he head the field testing of cloud seeding in Ohio. He eventually looked upon this assignment as a public duty to assist in clearing up the widely published claims to "rain-making" in large amounts by seeding the clouds. When the first reports of the spectacular effects of dry ice and silver iodide scattered on certain forms of clouds were announced in 1946 and 1947 the Weather Bureau hailed the discovery as beginning a new era in experimental meteorology. But after several months' review of some of the highly speculative claims a summary statement was adopted by the Bureau emphasizing the importance of much more research in the basic natural conditions involved in condensation of moisture in the free air and precipitation of rain, snow,

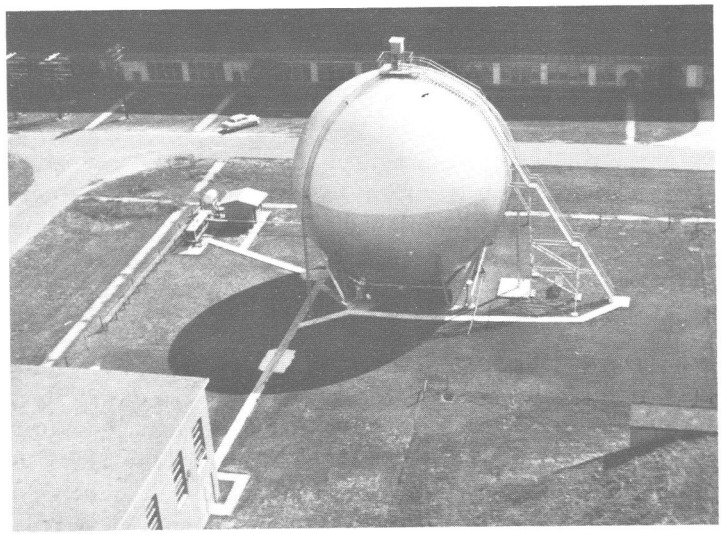

FIGURE 3.—Giant cloud chamber laboratory (former helium gas storage sphere) near Hitchcock, Texas (about 1953).

etc. The statement urged that the research be vigorously pushed in order to determine the true possibilities of artificial nucleation of clouds in view of the very great practical benefits that might result and advised that many of the "rain-making" claims then being published might be premature. It was pointed out that the claims were almost wholly without scientific verification. The statement brought violent criticism.

Gunn set about the field tests in a scientific way. His experiments in Ohio, supported by U.S. Air Force, Weather Bureau, and other government agencies, were the first of the kind ever performed anywhere under systematic procedures and with reasonably scientific controls for correlating times of seeding, occurrence of precipitation, etc. One morning early in the field test program Gunn phoned headquarters in Washington that he thought he had succeeded in "making a moderately heavy shower," but later after a time analysis of events had been made he reported that the shower had started *before* the cloud was seeded and may not have had any relation to the seeding. The incident was significant. In meteorology erroneous conclusions—the so-called "post hoc" error—are not uncommon. Other illustrations are the Savannah hurricane episode and the Florida seabreeze incident. After the tests in Ohio Gunn was requested to conduct tests in California under orographic conditions somewhat similar to warm front phenomena. Later, in Alabama and Louisiana flight tests in seeding tropical cumulus clouds were made. The results are documented in Gunn's published reports.

He sought the facts—the truth—and his careful tests did not confirm the claims of many rain-makers. His conclusions and the earlier statement by the Weather Bureau are in substantial agreement with the findings of an independent panel of scientists acting through the National Academy of Sciences more than a decade later [5, 6]. Having reached his conclusions on rain-making, Gunn returned in the early 1950's to basic research in cloud physics as the proper approach to unraveling the complexity of problems associated with precipitation.

4. RESEARCH PROFESSOR, 1958–1966

In 1957 Gunn decided that he had accomplished much of what he had planned when he came to the Bureau. He wanted more time for his work in certain problems in atmospheric physics and he also wanted time to develop the aircraft approach and landing system which he had visualized. He looked ahead eagerly to many more years of research and invention. In 1958 he became Research Professor in physics at American University, Washington, D.C., and continued in that position until his death October 15, 1966. Sponsored first by the Atomic Energy Commission and later by the National Science Foundation among others, he worked primarily on refinements and extensions of his earlier studies in atmospheric electricity, cloud physics, air pollution, and related geophysical subjects, especially isostasy. He also accepted occasional consultant opportunities. His environment at the University was to his liking. He was free to work on problems of his own choice.

Ross Gunn's life in science was interwoven with his home life and his family. At the office and in the laboratory he worked hard. He praised his associates and strongly supported them for promotion when merited. He was careful to give due credit to his co-workers. His family was close to him. Its vital part in his life, its active, congenial, and successful aspects, are only briefly mentioned here. All four sons are college graduates, three from the University of Michigan, one from Oberlin. Two earned Masters degrees, one completed work in the Yale School of Divinity, and the fourth son, an M.D., Harvard. Their mother, Gladys, was the family complement to Ross in many ways. He represented science; she gave more time than he could to cultural and church affairs. Evenings, weekends, and even during summer vacations at their Torch Lake home in Michigan—the periods he called his "re-creation"—Ross' mind was busy most of the time on scientific matters. He worked long hours on laboratory things at home. But he also gave generous support to the church and civic activities sponsored by Gladys.

Notwithstanding his absorption with science, Gunn enjoyed vigorous exercise—carpentering, ditch-digging, wood chopping, etc., at the Lake cottage, swimming and walking. The spacious lake front site in Michigan was called The Arsenal, the place where the Gunns were kept. The 38-ft. cruiser during the earlier years at NRL was the *GUNNBOAT*. He took great pleasure in weekend cruises on the Potomac during those NRL years. Brisk walks with a son or two through neighboring woodlands were frequent. Even during the most difficult days of the ACN and atomic propulsion for submarines projects Gunn's characteristic dry sense of humor sounded the pitch for good family relationships. He always liked the down-to-earth stories and anecdotes of his long-time friend Boss Kettering, and he often "indoctrinated" the boys in similar fashion.

Gunn lived a full and useful life. Many times he could have made it easier for himself if he had been less steadfast in his beliefs and more inclined to "exploit" the facts instead of expecting them to speak for themselves. He conducted himself unusually well in social and political events but he rarely sought them, and he held it to be beneath a true scientist to seek unmerited favor. Probably Ross Gunn would deem it the highest compliment to be regarded as a man of science—"good science"—a disciple of truth, justice, and high principle whose contributions are fundamental and enduring. These things he has achieved!

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